UNIVERSITI SAINS MALAYSIA

First Semester Examination
2015/2016 Academic Session

December 2015 / January 2016

EBP 303/3 – Plastic Materials
[Bahan Plastik]

Duration : 3 hours
[Masa : 3 jam]

Please ensure that this examination paper contains NINE printed pages before you begin the examination.
[Sila pastikan bahawa kertas peperiksaan ini mengandungi SEMBILAN muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]

This paper consists of SEVEN questions. ONE question in PART A, THREE questions in PART B, and THREE questions in PART C.
[Kertas soalan ini mengandungi TUJUH soalan. SATU soalan di BAHAGIAN A, TIGA soalan di BAHAGIAN B dan TIGA soalan di BAHAGIAN C.]

Instruction: Answer **FIVE** questions. Answer **ALL** questions from PART A, **TWO** questions from PART B and **TWO** questions from PART C. If a candidate answers more than five questions only the first five questions answered in the answer script would be examined.
*[**Arahan**: Jawab **LIMA** soalan. Jawab **SEMUA** soalan dari BAHAGIAN A, **DUA** soalan dari BAHAGIAN B dan **DUA** soalan dari BAHAGIAN C. Jika calon menjawab lebih daripada lima soalan hanya lima soalan pertama mengikut susunan dalam skrip jawapan akan diberi markah.]*

The answers to all questions must start on a new page.
[Mulakan jawapan anda untuk semua soalan pada muka surat yang baru.]

You may answer a question either in Bahasa Malaysia or in English.
[Anda dibenarkan menjawab soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris.]

In the event of any discrepancies in the examination questions, the English version shall be used.
[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah digunapakai.]

PART A / *BAHAGIAN A*

1. [a] (i) Explain what is compatibility and miscibility in plastic compounding/blending.

Jelaskan apakah keserasian dan kebolehcampuran dalam penyebatian/pencampuran plastik.

(20 marks/*markah*)

(ii) Discuss two (2) methods that can be used to measure miscibility in plastic compound.

Bincangkan dua (2) kaedah yang boleh digunakan untuk mengukur kebolehcampuran dalam sebatian plastik.

(30 marks/*markah*)

[b] High density polyethylene (HDPE), linear low density polyethylene (LLDPE) and low density polyethylene (LDPE) are all made from the same monomer. Explain the cause of the differences in structure of these polymers and give one example of product that can be made from each polymer.

Polietilena berketumpatan tinggi (HDPE), polietilena linear berketumpatan rendah (LLDPE) dan polietilena berketumpatan rendah (LDPE) dihasilkan daripada jenis monomer yang sama iaitu etilena. Terangkan penyebab perbezaan struktur polimer dan berikan satu contoh produk bagi setiap polimer.

(50 marks/*markah*)

PART B / *BAHAGIAN B*

2. [a] Explain interface and interphase in plastic compound with the help of a diagram.

Jelaskan antaramuka dan antarafasa dalam sebatian plastik dengan bantuan gambarajah.

(20 marks/*markah*)

[b] In plastic compounding, we need to break up filler agglomeration (if any) and to disperse the filler homogeneously in a compound. Give your comment on the quality of the compound (by giving suitable example) if

(i) distributive mixing was achieved but dispersive mixing was not achieved during compounding?

(ii) distributive mixing was not achieved but dispersive mixing was achieved during compounding?

Dalam penyebatian plastik, kita perlu memecahkan gelompokan/aglomerasi pengisi (jika ada) dan menyebarkan pengisi tersebut secara sekata di dalam sebatian. Berikan komen anda terhadap kualiti sebatian tersebut (dengan memberikan contoh yang sesuai) jika

(i) pencampuran distributif tercapai tetapi pencampuran dispersif tidak tercapai semasa penyebatian?

(ii) pencampuran distributif tidak tercapai tetapi pencampuran dispersif tercapai semasa penyebatian?

(40 marks/*markah*)

[c] Explain two (2) reasons on why we need to break up filler agglomeration by giving one example for each reason given.

Jelaskan dua (2) sebab mengapa kita perlu memecahkan gelompokan/aglomerasi pengisi dengan memberikan satu contoh untuk setiap sebab yang diberikan.

(40 marks/*markah*)

3. Given this scenario: Compounding between polyethylene (70 wt%) and short glass fibre (30 wt%) was done by using twin screw extruder. Dumbbell samples were prepared by using injection moulding. Tensile test was done and the result is shown in Table 1.

Diberikan senario berikut: Penyebatian antara polietilena (70 wt%) dan gentian kaca pendek (30 wt%) telah dilakukan dengan menggunakan ekstuder skru berkembar. Sampel dumbel disediakan dengan menggunakan pengacuanan suntikan. Ujian tensil telah dilakukan terhadap sampel tersebut dan keputusan ditunjukkan dalam Jadual 1.

[a] Compare and give your comment on tensile strength and standard deviation for both samples.

Banding dan berikan komen anda terhadap kekuatan tensil dan sisihan piawai untuk kedua-dua sampel.

(25 marks/*markah*)

[b] In your opinion, does distributive and dispersive mixing was achieved in composite sample produced. Explain your answer.

Pada pendapat anda, adakah pencampuran distributif dan dispersif telah tercapai dalam sampel komposit yang dihasilkan. Jelaskan jawapan anda.

(20 marks/*markah*)

[c] Is the same result as in Table 1 will be obtained if short glass fibre was replaced by calcium carbonate? Explain your answer.

Adakah keputusan yang sama seperti dalam Jadual 1 akan didapati jika gentian kaca pendek digantikan dengan kalsium karbonat? Jelaskan jawapan anda.

(20 marks/*markah*)

[d] Predict what would happen to the tensile strength if the filler loading was increased to 50 w%.

Ramalkan apa akan terjadi pada kekuatan tensil jika kandungan pengisi tersebut ditambah kepada 50 w%.

(15 marks/*markah*)

[e] Give two (2) suggestions to improve the tensile strength of short glass fibre filled polypropylene.

Berikan dua (2) cadangan untuk meningkatkan kekuatan tensil polietilena terisi gentian kaca pendek.

(20 marks/*markah*)

Table 1 - Tensile strength of unfilled polyethylene and polyethylene composite

Jadual 1 - Kekuatan tensil polietilena tanpa pengisi dan komposit polietilena

Sample *Sampel*	Tensile strength (MPa) *Kekuatan Tensil (MPa)*
Unfilled polyethylene *Polietilena tanpa pengisi*	50.0 ± 1.0
Short glass fibre filled polyethylene *Polietilena terisi gentian kaca pendek*	60.0 ± 8.0

4. [a] (i) Discuss two (2) plasticizers theory.

Bincangkan dua (2) teori pemplastik.

(20 marks/*markah*)

(ii) Explain polymer degradation process due to UV exposure by using schematic diagram.

Jelaskan proses degradasi polimer akibat pendedahan pada UV dengan menggunakan diagram skematik.

(20 marks/*markah*)

(iii) Discuss two (2) functions of filler in plastic compounding.

Bincangkan dua (2) fungsi pengisi dalam penyebatian plastik.

(20 marks/*markah*)

[b] Write short notes on the following topics:

(i) Nucleating and clarifying agents.

(ii) Two main classes of antioxidants.

Tuliskan nota ringkas berkenaan tajuk di bawah:

(i) Ejen penukleasan and kejelasan.

(ii) Dua kelas utama anti pengoksidaan.

(40 marks/*markah*)

PART C / *BAHAGIAN C*

5. [a] Define and explain briefly the classification of Plastic.

Berikan definisi dan terangkan secara ringkas pengkelasan bagi Plastik.

(20 marks/*markah*)

[b] Poly vinyl chloride (PVC) is said to have a heat history. What does it mean? How does this affect the processing and recycling of this thermoplastic in the industry? What can be done to facilitate the processing of this thermoplastic resin?

Jelaskan kenapa Poli (vinil klorida) dikatakan mempamerkan sifat sejarah haba. Apakah yang dimaksudkan oleh kenyataan ini? Bagaimanakah sifat ini mempengaruhi pemprosesan dan kitar- semula termoplastik ini dalam industri? Apakah yang boleh dilakukan bagi mempermudahkan pemprosesan resin termoplastik ini?

(50 marks/*markah*)

[c] Briefly compare the water absorption behavior of acetal and nylon and explain the difference(s) that are noted. In your opinion which engineering thermoplastic is more suitable to be used in water environments such as toilet tanks, shower heads, hose connections, and valve bodies?

Secara ringkas bandingkan sifat serapan air bagi asetal dan nilon dan jelaskan perbezaan yang diperhatikan. Pada pendapat anda termoplastik kejuruteraan yang manakah yang lebih sesuai untuk digunakan pada persekitaran air seperti tangki tandas, 'shower head', penghubung paip penyalur, dan 'valve bodies'?

(30 marks/*markah*)

6. [a] Describe in details the chemical structure, processing, physical properties and suitable application for poly(methylmethacrylate) (PMMA).

Jelaskan secara terperinci berkenaan struktur kimia, pemprosesan, sifat-sifat fizikal dan kegunaan yang bersesuaian bagi poli(metilmetakrilate) (PMMA).

(30 marks/*markah*)

[b] Give your opinion on the suitability of using high-density polyethylene (HDPE) film to wrap and seal bakery items?

Berikan pandangan anda tentang kesesuaian filem polietilena berketumpatan tinggi digunakan bagi membungkus dan menutup produk-produk berasaskan roti.

(40 marks/*markah*)

[c] Briefly discuss the following statement, "Nylons are formed by condensation polymerization from monomers that combine to make amide groups with water as a by-product. These amide groups influence most of properties exhibited by nylons".

Secara ringkas bincangkan kenyataan yang berikut, "Nilon dihasilkan melalui pempolimeran kondensasi di mana monomer akan bergabung membentuk kumpulan amida dengan air sebagai hasil sampingan. Kumpulan amida ini mempengaruhi kebanyakan sifat-sifat yang dipamerkan oleh nilon".

(30 marks/*markah*)

7. [a] Explain the significant properties of engineering plastic as compared to commodity plastic.

Terangkan berkenaan sifat-sifat bagi plastik kejuruteraan yang signifikan berbanding dengan plastik komoditi.

(20 marks/*markah*)

[b] Both linear low density polyethylene (LLDPE) and low density polyethylene (LDPE) have unique rheological or melt flow properties. Discuss their behaviour under shearing process and melt extension. Suggest the suitable processing method for each polymer.

Kedua-dua polietilena berketumpatan rendah linear (LLDPE) dan polietilena berketumpatan rendah (LDPE)mempunyai sifat-sifat reologi atau 'melt flow' yang unik. Bincangkan sifat-sifatnya di bawah keadaan proses ricihan dan 'melt extension'. Cadangkan kaedah pemperosesan yang sesuai bagi setiap polimer.

(40 marks/*markah*)

[c] Compare the difference(s) for engineering-grade polyethylene terephthalate (PET) with standard-grade polyethylene terephthalate (PET) based on the chemistry and physical properties of the polymers.

Bandingkan perbezaan bagi polietilena terefetalat (PET) gred-kejuruteraan dengan polietilena terefetalat gred piawai (PET) berdasarkan sifat-sifat kimia dan juga sifat-sifat fizikal bagi polimer tersebut.

(40 marks/*markah*)

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